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ABSTRACT

Pima Community College produced self-paced individualized mediated drafting instruction to meet the needs of students with different skills, abilities, motivation, and experience. Areas of instructional information for skills of an introductory nature were divided into 13 units of instruction. These units were divided into areas of difficulty/modules: introduction (units 1-6), basic (7-9), and intermediate (10-13). Each unit was independent of any other within the same module. Units did not need to be done in sequence, but modules were to be completed in order. Each unit consisted of a carousel of slides, cassette tape, and worksheets. The final examination was an instrument used for employment evaluation by industry of entry level skills for drafting applicants. It had been used as the final examination for all first level drafting students the previous year. No significant difference in student performance or retention was found between control and experimental groups. Other significant observations were improved student attitude, flexible laboratory time for students' convenience, and students' receiving individual attention as needed. Hardware and software were kept in house for the students' convenience. The Drafting Room Manual was produced as a text for the mediated program. (A description of the format is provided.) (YLB)

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SELF—PACED MEDIATED DRAFTING INSTRUCTION

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INTRODUCTION

Pima Community College first opened its doors to students in September, 1970, with an initial enrollment of 3,728 students. In the brief period of nine years, enrollments have spiralled upward to 20,000 students and the original location has been expanded to a four campus operation. The use of 60 satellite facilities is part of the overall philosophy of bringing education to the people of Pima County. During the 1974-75 school year Pima College was awarded full accreditation by the North Central Association of Colleges and Secondary Schools. The national accrediting agency attached no conditions to accreditation and stated there would be no further review for five years, the maximum time allowed. This accreditation was a remarkable achievement for an institution only five years old.

A large part of our success can be attributed to the exploration and development of new methods of delivering educational services to better serve the wide variety of students to be found within the community college environment. This exploration, development and final implementation could not be accomplished without full cooperation of all segments within the institution; administrators, faculty, and staff.

SELF-PACED INDIVIDUALIZED MEDIATED INSTRUCTION

Much has been written regarding the classroom instructor and his role of lecturer and demonstrator in presenting educational material. In recent years, many articles have been published discussing the change in the role of the educator brought about by the teaching machine and its counterpart, programmed learning.

At the 1964 convention of the American Vocational Assn. John Shemick presented a paper which examined a study utilizing a teaching machine to present an exercise in spinning a small metal bowl. One-half the class of 20 students received instruction through use of slides, while the remaining students received a teacher — centered lecture and demonstration. There was no significant difference between the groups as to number of trials and quality of workmanship. It was concluded, however, that the teaching machine consumed less of the student's time in performing the task and more of the teacher's time in individual assistance.

Commercial application of the teaching machine to the area of electronics was attempted at the Hughes Corporation. A series of step-by-step electronics assembly procedures were programmed for use with the Hughes Videosonic Communications System. An article in Aviation Week (January 1960) reported a 99% reduction in employee errors and a 60 to 90 percent increase in standard production during a ten month trial period.

Many other studies utilizing teaching machines have been carried out over the years including the following: James McMurry and Armond Hoffer - University of Missouri - 1964; Norman Sprankle (1965) and Charles Hayes (1967) at California State College at Long Beach. The published data from these and other researchers indicate one common point: there was no statistical difference in student performance or retention between the two presentation methods; teacher lecture versus teaching machine. There were, however, two decided benefits to machine instruction; the ability of a student to set his own pace, and the resulting freedom of the instructor to concentrate upon those students most in need of his personal attention.

These two factors, freedom of the student and the instructor to use their talents most productively, were the deciding factors of the decision to produce self-paced individualized mediated drafting instruction at the Downtown Campus of Pima Community College. Drafting at Pima is both a degree program for students desiring entry-level skills, plus support program for courses requiring limited drafting skills in other professions such as sheet metal, air conditioning, machine shop, and welding. Thus students entering our drafting courses lacked homogeneity in skills, abilities, motivation, and experience. Teaching to the lower level produced large numbers of drop-outs among more advanced students. Speeding up and/or raising the level of the course material would produce an equally large defection of lower level students. Setting up separate curriculum and classes for each of the various levels would have created an impossible paperwork load and insurmountable scheduling difficulties due to class size minimums and maximums. Thus individualized self-paced instruction appeared to hold the solution to the problem, and during the summer of 1978 we produced our own self-paced individualized instruction for Drafting using the 35 mm slide and cassette tape format.

Designing individualized mediated drafting instruction required first dividing the instructional material into units of instruction. Areas of instructional information required for skills of an introductory nature were unitized as follows:

1- Introduction to equipment and their use.
2- Straight lines (The drafting machine)
3- Arc and Circles (The compass)
4- Free-hand Sketching
5- Geometric Construction
6- View Visualization
7- Orthographic projection
8- Dimensioning
9- Sections
10- Auxiliaries
11- Pictorials
12- Developments
13- Threads and Fasteners

Thus it was decided that we would require a minimum of thirteen separate films with accompanying tapes. Allowing each student to proceed at his own pace would require a minimum of 11 films per unit per section; assuming 50% utilization of the 22 work stations available. Thus we were looking at a total of 143 films and tapes; a physical impossibility space wise, and a monetary impossibility budget wise.

A solution to the numbers problem was achieved by modulizing the units. The 13 units were divided into areas of difficulty; introduction, basic, and intermediate. The introductory module included units 1 thru 6, the basic module contained units 7 thru 9, and the intermediate module contained units 10 thru 13. Each unit of instruction within a module was completely independent of any other within the same module. Thus students need not work in sequential form within any module. The only requirement was that all units of Module 1 must be completed prior to starting on Module 2, and all of Module 2 was to be completed prior to commencing on Module 3.

After much experimentation we were able to develop slides and tapes within each module that were completely independent of other units within that same module. From an original anticipated total of 143 tapes and films, our requirements were reduced to a total of 38 tapes and films. Assuming 4 films of each unit and 6 units to Module 1, only a total of 24 individual films needed to be available during any one period. Modules II and III required only 14 films available at any given moment, two of each of the seven units, because of the differing rates of student progress as the program advanced from basic to intermediate.

Each completed unit of instruction consisted of a carousel of slides plus a cassette tape cued to advance the slides as well as pausing the program whenever the student was called upon to perform. Worksheets were developed and included within each unit of instruction, guiding the student through the performance objectives. Upon completion, the worksheet would be reviewed by the instructor who then assigned a project to the student. The project covered the same unit of instruction, only this time the student was expected to complete the assignment without the aid of media. All assigned work allowed full use of text materials and students were encouraged to use their Drafting Room Manual at all times.

The self-paced individualized mediated drafting instruction became operational for the fall semester, 1978. Needed improvements in audio/visual presentations as well as assigned worksheets and projects were made during the school year as indicated by classroom experience. A final examination issued at the end of each semester was used to evaluate student retention and level of ability. The examination utilized was an instrument used for employment evaluation by industry of entry level skills for drafting applicants. There were multiple choice questions covering ten of 12 units of instruction. Units 2 (Straight lines) and 3 (The compass) were not included with the examination.

The same examination had been utilized as a final exam to all first level drafting students for a period of one school year (1977-78) prior to initiating the self-paced individualized instructional program. Prior to the introduction of the self-paced instruction, all classes were conducted by conventional methodology. Thus we were able to establish a control group using standard teacher lecture demonstration techniques and to compare student achievement with those receiving instruction through the mediated approach.

Comparing the curves of the control group with those of the experimental group showed no significant difference in student performance or retention. Thus the results at Pima Community College seem to confirm the conclusion of those involved in earlier experimental programs of mediated instruction. However, while student retention and performance remained the same, there were some significant observations that were beneficial goals of Pima Community College.

1- The student seemed more aware of his personal aims and was happier with his achievements despite the experimental data showing no actual gain in achievement over normal teaching practices. Improved student attitude was based upon an anonymous questionaire distributed at the end of each semester.

2- Students were free to do extra and/or make up work at their convenience. Open lab was from 8:00 AM to 10:00 PM and students were encouraged to use the lab facilities at any time. There were cases where employed students would have their working shift changed from day to night, or visa versa; a very common occurance with one of Arizona's largest employers, the mining industry. When this occured the student involved would switch from night to day lab hours with no loss in time or continuity. This change of scheduling has been known to occur as many as three times in one semester.

3- The student received individual attention when and as needed. Basic drafting at Pima College is the first drafting course and has no pre-requisits for entry. The advanced and/or more capable student could now proceed at his own pace, and some have completed the required work in as few as ten weeks of the normal 15 week program.

The average student usually requires the entire 15 weeks to complete the 13 units of work contained within the three modules. Course content has been designed for the average student and revisions have been made to insure the 15 week (90 Hour) limitation.

Slower students now have the full services of individual instruction. Increased attention by the instructor appears to have a positive effect on student retention as many more students are completing the 15 week program.

There is even a place for those who cannot seem to complete the required work in 15 weeks. This student is encouraged to sign up the following semester to complete the remainder of units he is missing. Thus continuity is continued and unnecessary repetition of material is minimized. Further, there is no grade penalty as the grade is based upon individual ability and performance, and not on speed. Thus quality always remains superior to quantity.

HARDWARE and SOFTWARE

The classroom contains twenty-two commercial drafting tables, (4 X 5 feet) each with a commercial drafting machine. Drafting machines include both arm type units and track type consoles. Thus the student attains the capability of using both styles. Each drafting position is equipped with a caramate rear screen projector audio visual unit having remote control facilities. The problem of mounting the audio/visual projectors was solved by utilizing a TV mounting platform designed for travel trailers; a commercial product available at minimal price. These TV platforms allow the projecting arm to swing forward for loading and unloading of

slides and tapes, then swings the unit to one side when the drafting board is in use. It further allows rotating the projector to a 90° viewing position, which is very important. To receive maximum film brightness under the high level of illumination, the student must look directly into the viewing screen. Remote control units are provided, which together with the swinging arm, allows a maximum unobstructed working surface for the student. Maintenance of the equipment has been minimal and down time negligable. Thus the slide-tape format appears more economical both in original cost and in upkeep than other forms of mediated equipment available. Further, the 35mm slide format allows a much larger and clearer picture than movie film and is more conducive to changes in format. The improvement in content and quality of the program has been a joint effort between the drafting department and the audio visual media department of the Downtown Campus. During the operational period of this program we have developed our own color film processing capabilities. Thus all film is now done "in house" at minimum cost.

Carousel slide trays are kept in a standard metal cabinet and are available to students as needed. Each carousel box contains the worksheets relevant to that unit, and in sufficent quantities for current enrollment. Pre-recorded cassette tapes are kept in an adjacent cassette file cabinet, to which the student also has free access. Master tapes are retained in the audio-visual department, allowing additional copies to be obtained within one working day when necessary. This is possible through use of a cassette copier that will produce both tracks of a single tape in about three minutes.

One problem area developed when a student was forced to leave the classroom prior to completing a mediated unit, as all synchronization between slides and tape is lost when they are removed from the projectors. This was solved by preparing extra tapes. The student now removes his tape, lists the slide number upon it, and files it in a pre-assigned drawer. When returning to class he inserts his tape, rotates to the slide listed upon the tape, and continues on where he left off the previous day.

All worksheets are standard 8½ x 11 sheets with a full supply for the school year stored in standard file cabinets within the drafting room. Thus additional worksheets are immediately available to refill the carousel boxes. Separate worksheets of a remedial nature are also available in the same file cabinet. Thus many different problems are available for students requiring additional work within each unit of instruction. Projects are done on vellum of various standard cut sizes A through D. The student supplies his own vellum to fit his particular project, and the school supplies the blue-print paper. Many projects are available for each unit; sufficient to insure that no two students in any period will be working on the same problem.

The overall intent behind our adoption of a self-paced mediated form of drafting instruction is to make the drafting student self-sufficient and have the student gain confidence in his abilities as a draftsman. Cooperation between students is encouraged along with the use of the vast resources available through our Alternative Learning Center and Library including, but not limited to, a complete set of ANSI Specifications as well as MIL Standards, audio-visual filmstrips, and selected texts on drafting and related fields.

Selection of a standard text-book prior to preparing for the mediated program had proven to be an arduous task. Many texts were tried including Luzadder, Giesecke, Jensen, and others; but each were eliminated after a semester's use. Our students just would not, or could not, read assigned work from existing text material. The matter was discussed with other drafting instructors, reading specialists, learning specialists, industry personnel, and even staff psychologists. The concensus reached was:

1. The reading level of most drafting texts was too high (11-13th grade) for the average entry-level community college vocationally oriented student.
2. Material was not presented in a manner conducive to a beginning course having no pre-requisites. There was no continuity evolving from the simple to the complex. Thus most information presented required explanation through instructional lectures not suited to the intended mediated instruction. This was particularly apparent in the heavy usage of technical terms not being fully explained to the beginning level.
3. Most texts contained information considered superfluous to a student preparing for entry level skills within the drafting profession. This superfluous information, much of it relating to specialized areas such as welding, piping, electronics, etc., tends to confuse the beginning student. Industry personnel recommended that we teach the basics and allow industry to implement the specialization.
4. Too much space was devoted to standard classroom exercises. Thus the student becomes aware of his assigned work before he even enters the class. There is also extensive copying without learning and the subsequent overlooking of the individual student weaknesses by the instructor. Perhaps worst of all is the students tendency to "think" with the book instead of relying upon his own intuitive processes; thus he cannot grasp the similarity of alternative problems.

At that point, unable to find a suitable text available, I found it necessary to produce my own book, designed originally to implement the planned self-paced mediated instruction; a text that has since been incorporated into drafting courses using standard teacher lecture-demonstration techniques. Thus was born the Drafting Room Manual (DRM), which proved to be the final link to producing successful mediated instruction.

As the Drafting Room Manual evolved it became apparent that it could meet the needs of instructors and students involved in any basic course of Mechanical Drafting. The text is designed for grades 10-14; upper high school through and including community college, vocational and trade schools, and lower university level. There would be no prerequisites to this text, and the information contained within the text would be suitable to a one year beginning drafting program.

For many years drafting instructors have maintained that drafting is a "graphic" language, yet texts in use are profusely verbal. Most major industries produce their own drafting texts listing the requirements of their drafting departments (both general and specialized). These industry materials follow closely the suggestions as stated by the American Institute of Design and Drafting:

1. Can it be said with fewer words? Writing a reference work isn't particularly difficult. It only requires that you give words the same thrifty respect you give money.

2. Is this explanation necessary? Does this explanation answer a question likely to confront a draftsman?

3. Does this belong in the DRM? Material should be limited to information useful to drafting personnel. It should be indexed and arranged for ready reference.

4. Will an illustration explain this better? One small sketch will sometimes save several pages of text.

The format of the DRM is as follows:

A. Page size is 8½ x 11 to allow full scale illustrations.

B. The page position is horizontal rather than vertical to follow the proportions of industry drawings.

C. Each set of 8½ x 11 pages stands alone with a full page illustration immediately next to the explanation on its own 8½ x 11 page. There is no need for the student to flip pages to find explanations of given illustrations.

D. Material is bound using large wire coils, allowing the student to open his text flat while working. Thus the DRM is as much a reference text as a text book.

E. Blank pages are provided allowing additions at the discretion of the instructor and/or student.

F. It is anticipated that the DRM will become a valuable piece of reference material that can be expanded upon. The student will thus be encouraged to keep and maintain his DRM as opposed to the present practice of trading in his text as soon as the course is completed.

G. The number system used assigns a separate subnumber to each rule or practice. Instructors need only place a number upon the students incorrect work; forcing the student to refer to his DRM to determine the reasoning behind the correction.

ie. 10.12 would mean poor dimensioning practices. The student must now review section 10.12 to determine his problem.

This constant re-inforcement of the student's weak areas should prove a valuable aid.

The DRM was written under the format of drafting standards following the procedures of the ANSI (American National Standards Institute), but changes have been made to reflect a student level. Therefore each sub-title has its own numbering sequence. A student using the DRM shall have no problem locating information when presented with another drafting manual from either industry or government. Subject material progresses from the simple to the complex. Architectural drafting has purposely been omitted due to the many procedures peculiar to this field that seemingly violate the rules of good mechanical drawing, ie: printing styles, pictorial representations, and the techniques of measuration.

Illustrations basically consist of standard drawings of industry. There is at least one line drawing for each title listed, or approximately 200 drawings to 500 pages of material.

Completion and publication of the Drafting Room Manual (see appendix) has completed the mediated instructional package for the basic drafting program at Pima Community College. Development of this program has been exciting, producing many challenges and subsequent solutions. However, it is not our intent to stop here as we shall continue to seek improvement of the existing program as well as expansion of mediated instructional techniques into our advanced drafting programs. While perhaps not a complete answer to the perfect methodology, if indeed there is a perfect methodology, self-paced mediated instruction has definitely proven superior to standard teacher centered lecture-demonstration techniques at Pima Community College.